



inps journal

Indiana Native Plant Society

Winter 2021-22

Water-Lilies: the Upside Down Plants

By Paul Rothrock

Aquatic flowering plants, such as water-lilies (genus *Nymphaea*), have a difficult life.

In the plant world, too much water is as bad as too little. Among the challenges presented to plants by living in water are difficulty of absorbing

minerals in low oxygen environments as well as supplying the gases needed for photosynthesis (carbon dioxide) and cell respiration (oxygen). Not surprisingly, then, fully aquatic flowering plants such as water-lilies, with their floating or submergent leaves,

account for only 4% of our Indiana species.

Typical plants have leaves arrayed in an atmosphere where gaseous carbon dioxide can be absorbed for use in photosynthesis. These carbon atoms find their way into organic sugars and other vital compounds. Even in terrestrial plants the acquisition of carbon dioxide is challenging since the gas is less than 0.1% of the atmosphere. Water-lilies have their leaves floating on the surface of water, thus one side is potentially cut off from the atmosphere. It is even worse for those aquatic plants that grow completely submerged in water.

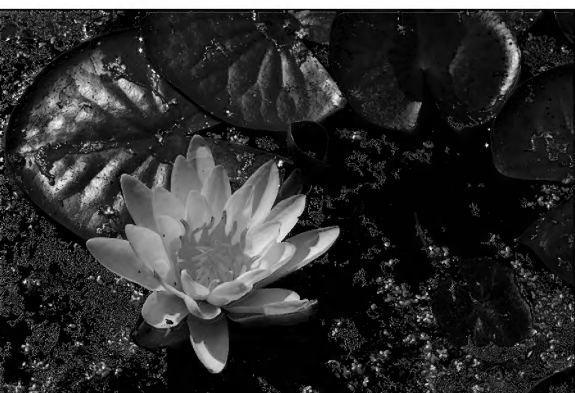
Acquiring carbon is not the only problem. Water-lily roots and rhizomes breathe, in the sense that they need oxygen for their metabolism just as animals do. For terrestrial plants, loam soils offer plenty of atmospheric gases in their pore spaces. But the aquatic environment is oxygen poor, especially in the substrates in which roots are anchored. The

lack of oxygen presents a further dilemma since in oxygen poor soils nutrients such as nitrate, manganese, iron, and sulfates are reduced to insoluble forms that roots cannot absorb.

So, two gas problems confront water-lilies and their kin – how their leaves can obtain sufficient carbon dioxide and how to have enough oxygen to sustain their roots and rhizomes and enhance nutrient uptake.

Inside

| | |
|-------------------------|-------|
| Book Review | 12 |
| Botany Basics | 1 |
| Conserving Native Flora | 16 |
| Florathon | 9 |
| INPS at Work | 6 |
| Invasive Plant Profile | 2 |
| Native Plant Profile | 14 |
| Natural Area | 4, 20 |
| Wild Edibles | 10 |



Paul Rothrock

White water-lily (Nymphaea odorata) and its two subspecies occur in Indiana, especially in the northern quarter of the state. The flower pictured is in its male pollen-shedding phase.

To supply carbon dioxide, plant leaves have numerous pores called stomata. Typically these are abundant on the lower epidermis, but are scarcer or even lacking on the upper epidermis. Guard cells can open and close these pores in order to control water loss when carbon dioxide is not needed or when the plant is experiencing drought conditions. Here is our first instance where water-lilies seem to be upside down. They possess a remarkable placement of stomata – only on the upper epidermis! As a further twist, given that preventing water loss is not a big issue for water-lilies, their stomata do not have guard cells and remain permanently open.

Water-lilies have a second amazing upside down phenomenon. Generally we think of roots as supplying the leaves with raw materials from the environment. In water-lilies, the aerial parts of the plant act as the conduit for one of the

Water-Lilies — continued on page 3

What's Happening with Garlic Mustard? Potentially a Good News Story

By Rich Dunbar

Early in my work managing nature preserves in northern Indiana, purple loosestrife (*Lythrum salicaria*) was a looming problem in a number of our properties. I became part of a loosely allied group of biologists interested in testing biocontrol agents to combat this invasive plant and we saw favorable results. Encouraged, we decided to turn our attention to garlic mustard (*Alliaria petiolata*). And, after several years of effort, we were able to get funding to search

for a biological control insect that would be specific to that species.

As part of preparations for the eventual release of biological control agents we established permanent sampling transects across the northeastern U.S., including two in northern Indiana. We selected transect sites that we thought would be good as eventual release sites. They had near continuous cover of adult garlic mustard and no management that might affect garlic mustard. We sampled the

transects twice a year for ten years while the search for biological control agents went on.

Then, a funny thing happened. Garlic mustard declined dramatically on all the transects, even though no agents were released. You can find the data in Blossey et al. (2021). Put in everyday experience, when we started sampling in Indiana, it took us most of a day to sample a transect, counting and measuring stems, fruits, etc. By the end of ten years, sampling only took us a couple hours or less. Quadrats that were once packed with tall garlic mustard stalks had one or two adults, or in many cases no adults. I have observed similar declines in other garlic mustard stands that have not been managed.

We do not know what caused the decline. Nothing is evident above ground or in the roots, so we suspect an unknown soil pathogen. The paper cited above points to that in a preliminary way, referring to it as "negative soil feedback."

What does this mean for those of us who care about Indiana's wildflowers and natural communities? The declines observed are similar to what we might have hoped for from a successful biological control program, so most biologists have tabled those efforts for now. Clearly, though, we need to learn more about the deeper ecology of garlic mustard.

Should you continue to pull garlic mustard or leave it to our unknown control agent? At Olin Lake Nature Preserve we have been pulling garlic mustard for 29 years. A paid and dedicated crew still spends several days each year crisscrossing the preserve pulling garlic mustard. We have probably reduced garlic mustard populations below what the control agent would have done alone, but we cannot know how much of the long-term decline is due to our efforts and how much is due to the unknown agent. By pulling garlic mustard are we suppressing the unknown agent? We do not know. On a hunch, I would not attack first-year rosettes. There is significant mortality between first and second years of this biennial plant. That may be where the hypothesized pathogen is working and persisting from year to year.

Will spring wildflowers recover as garlic mustard declines? Based on my hands and knees experience, if spring wildflowers are present they can persist under garlic mustard. And these wildflowers are in a position to prosper as garlic mustard declines.

What about native pollinators, especially the West Virginia White butterfly (*Pieris virginiensis*), that are fatally attracted to garlic mustard over their native hosts (Davis et al. 2015). Having fewer garlic mustard plants around due to their decline should help. If by pulling you can significantly reduce garlic mustard, you may be doing pollinators a favor.

Does this news about garlic mustard mean we do not need to worry about other non-native plants? Not at all. I could show you lots of places where dense stands of non-native plants have persisted over many years and native plant communities no longer exist. But don't assume we know all that is going on. Although we will not have the resources to do as much long-term plant monitoring as

Garlic Mustard — continued at right



Paul Rothrock

This drift of garlic mustard, newly invading a disturbed woodland, was a target of a spring clean-up day.

Research indicates that the population may decline naturally over time due to "negative soil feedback." More research is warranted.

Water-Lilies - continued from front page

critical raw materials, gaseous oxygen. And this breathing of oxygen into the roots is done by physical processes rather than some form of active metabolism.

The leaves, stems, and roots of water-lilies and other aquatic plants have large air passageways through them. Botanists call this tissue aerenchyma (pronounced *air-en-ki-ma*). So at the simplest level, gases can diffuse through these airways and many aquatic plants only rely on diffusion. However, water-lilies do more.

Imagine the HVAC of a building. It uses fans to push air through the ductwork. While water-lilies lack miniature fans, they do have a way to push oxygen through the aerenchyma channels. It begins in young leaves that have many small stomata (less than 0.1 um in size) and rich pigmentation. As the leaf absorbs sunlight, the temperature of

the leaf interior warms and builds a pressure. Some of that pressure can be relieved through the tiny pores, but the line of least resistance is through the aerenchyma.

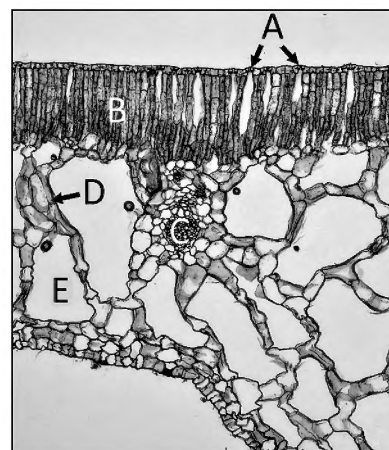
Meanwhile, older leaves of the plant may be attempting to build pressure through that same absorption of sunlight. But the ability of their aging tissues to absorb sunlight is lesser and furthermore the old leaves are more leaky. In the plant as a whole then, there is high pressure at the young leaves, lower pressure at the old leaves, and a thorough set of air passageways between them via the roots and rhizomes. The resulting pressurized ventilation is so effective that air moves up to 20 inches per hour (50 cm/hour) or enough volume to pump over 20 quarts (22 liters) of air through the plant per day (Cronk & Fennessy 2001). After the initial discovery of pressurized ventilation in water-lilies, similar ventilation systems were observed for some other aquatic plants, namely in the genus *Eleocharis*, *Phragmites*, *Schoenoplectus*, and *Typha*.

By the way, as that oxygen moves through the rhizome and roots a portion of it leaks into the adjacent substrates. The narrow oxygenated zone around the roots is enough to liberate some of those nutrients, such as nitrate, that would otherwise be unavailable.

There you have it. The upside down water-lilies place their stomata on the “wrong” side of the leaf for effective uptake of gases (both carbon dioxide and oxygen) and use a passive hydraulic system to pump a needed raw material (oxygen) from the aerial parts of the plant to the roots. Both are wonderful adaptations to life in a challenging environment.

Reference

Cronk, J.K. & M.S. Fennessy. 2001. *Wetland Plants: Biology and Ecology*. CRC Press, Lewis Publishers, Boca Raton, Florida. 462 pp.



A transverse section of a leaf from water-lily as seen through the microscope.

A = stomata; B = primary photosynthetic layer; C = vascular tissue that moves minerals and sugars; D = ordinary plant cells; E = large air space within the aerenchyma tissue.

Garlic Mustard — continued from left

we would wish, we should pay attention, take notes or photographs, and be prepared to have our concepts challenged, and maybe even encounter an occasional surprise!

References

- Blossey, B., V. Nuzzo, A. Dávalos, M. Mayer, R. Dunbar, D.A. Landis, J.A. Evans & B. Minter. 2021. Residence time determines invasiveness and performance of garlic mustard (*Alliaria petiolata*) in North America. *Ecology Letters* 24:327–336.
- Davis, S.L., T. Frisch, N. Bjarnholt & D. Cippolini. 2015. How does garlic mustard lure and kill the West Virginia White butterfly? *Journal of Chemical Ecology* 41:948–955.

Additional Reading

The Midwest Invasive Plant Network (MIPN.org) remains cautious about this recent research. They explain their position and include a useful decision chart about when to manage garlic mustard invasions at https://bugwoodcloud.org/mura/mipn/assets/File/MIPN_GMMManagement_Sept2021_Final.pdf

Rich Dunbar is the Northeast Indiana Regional Ecologist for the Indiana Department of Natural Resources, Division of Nature Preserves.

Paul Rothrock taught Plant Physiology at Taylor University before his retirement in 2014. He is a member of the South Central Chapter of INPS.

Beanblossom Bottoms Nature Preserve,

By John Lawrence

Drive north from State Road 46 on Union Valley Road near Ellettsville, wind past Oliver Winery's Creekbend Vineyard, and descend the steep curvy road that crosses the sluggish Beanblossom Creek. You are now sitting on an ancient lake bottom formed before the last ice age, the site of a Sycamore Land Trust natural area called Beanblossom Bottoms Nature Preserve.

The first parcel was acquired in 1995 and the property now totals over 700 acres in size, thanks to the support of Sycamore's members and many conservation partners. It has been dedicated as

an Indiana state nature preserve by the DNR in recognition of its statewide significance.

This extensive wetland is home to the federally-endangered Indiana bat (*Myotis sodalis*), the state-endangered Kirtland's snake (*Clonophis kirtlandii*), a pair of nesting bald eagles (*Haliaeetus leucocephalus*), bobcat (*Lynx rufus*), and numerous amphibians and songbirds. Of course, the plant list (<https://midwestherbaria.org/portal/checklists/checklist.php?clid=5502&pid=124>) is impressive too (thanks to the efforts of Ellen Jacquart and Paul Rothrock), with over 200 native species, especially those of swamps, sedge meadow, and marshes.

As you begin down the first leg of the 2.5 mile trail, it is difficult to believe that much of the area was agricultural fields 30 years ago. Today, with the drainage canal blocked by a beaver dam, it is common for ankle deep water to cover large portions of the property in spring and early summer. However, the faint of heart should not worry. Thanks to contributions by many donors, especially from the Nina Mason Charitable Trust to support a recent renovation, an extensive boardwalk system puts you above the normal water level. As you start the boardwalk you are immediately surrounded by a remarkable sight. The fast-growing swamp cottonwood (*Populus heterophylla*) is abundant here, even though it is infrequent in the regions drained by the Wabash, Ohio, and lower Mississippi rivers. Hanging close to the boardwalk are branches of buttonbush (*Cephalanthus occidentalis*), with globe-shaped clusters of white flowers in July, and swamp rose (*Rosa palustris*). The flowers of wild roses offer a simple beauty compared to their cultivated cousins.

Along the loop trail one crosses the old drainage canal with its film of tiny duckweeds (*Lemna* and *Wolffia* spp.). Here, in early summer, one encounters a spectacular display of Virginia blueflag (*Iris virginica*) and lizard's tail (*Saururus cernuus*). A tornado touched down nearly three years ago, knocking down many mature trees and requiring extensive clearing of the boardwalk. The new opening quickly sprang to life, a lesson that in an

The prothonotary warbler nests in wooded swamps such as Beanblossom Bottoms.



Chris Fox



Above: The boardwalk winds through a young swamp woods with a dazzling spring display of golden ragwort (*Packera aurea*) and bulbous bittercress (*Cardamine bulbosa*).

Right: A wildlife camera frequently captures video of bobcats (kittens seen here at night) and other mammals. Photo courtesy of Sycamore Land Trust.



a Southern Indiana Wetland Wonderland

ecosystem death can beget life.

Ahead is an observation platform that begs one to pause, listen, and watch. On warm spring evenings you undoubtedly will hear the gunk and croak of frogs and toads. At the height of their breeding season, the multitude of tiny spring peepers (*Pseudacris crucifer*) is surprisingly loud. Red-headed woodpeckers (*Melanerpes erythrocephalus*) may be scouting the sky. During the summer, flame-yellow prothonotary warblers (*Protonotaria citrea*), our only cavity-nesting warbler, sing *sweet sweet sweet* to announce their territories. Going farther down the trail, with a sharp eye you might spot the diminutive northern tubercled orchid (*Platanthera flava* var. *herbiola*).

Thanks to our on-going land stewardship efforts, the property is remarkably free of invasive species. As with any wetland we do work to control reed canary grass (*Phalaris arundinacea*) and watch for hybrid cat-tail (*Typha × glauca*). Our local botanists tell us, though, that the cat-tail along the trail appears to be the native broad-leaf cat-tail (*T. latifolia*), given the width of the leaves and the proximity of the male spike to the female. According to Wilhelm & Rericha (2017) these are rich pollen sources for native bees.

Undoubtedly, the best place in much of southern Indiana for seeing wetland sedges is Beanblossom Bottoms. Paul Rothrock has identified 25 species. These include dramatic ones (such as *Carex lupulina* and *C. squarrosa*), species at their northern range limit (*C. louisianica*), and particularly beautiful ones (*C. crinita*). Also in great profusion in late summer are stands of another sedge, wool grass (*Scirpus cyperinus*). I left the sedges for last in order to highlight our big surprise. If you cannot visit Beanblossom Bottoms in person or if you want to see its summer glory from the comfort of your winter home, we have a virtual tour online. Paul Rothrock and I spent a perfect June morning on the boardwalk and you can see it at <https://www.youtube.com/watch?v=Y7ixUxQwv3Q&t=2239s>. So whether live or online, you are invited to explore this wetland wonderland.

Reference

Wilhelm, G & L. Rericha. 2017. Flora of the Chicago Region: a Floristic and Ecological Synthesis. Indiana Academy of Science, Indianapolis.

John Lawrence is the Executive Director of Sycamore Land Trust and a longtime member of the INPS South Central Chapter.



All photos by Paul Rothrock



A gallery of common showy flowering species and when they bloom. From top downward: buttonbush (July), swamp rose (July), lizard's tail (June), and Virginia blueflag (June).



Native Plantings at the Eiteljorg Museum

By Coralie Palmer

In the heart of Indianapolis, the iconic Eiteljorg deer now emerge from a backdrop of native perennials, and the striking facade of the museum will next year be softened by the swaying grasses and bright summer yellows of a native tallgrass prairie.

The INPS Landscaping with Natives Team is excited to share the story of our collaborative partnership with the Eiteljorg Museum, Purdue University Extension – Marion County, Marion County Master Gardener Association, and the Indiana Wildlife Federation. The first two areas of this multi-phase, multi-year project have been completed – the Whitetail Deer Fountain was planted in May, and the prairie border in October.



Planting tallgrass prairie species, October 4.



Completed planting of tallgrass species, ready for winter.

An Opportunity to Work Together

Early in 2021, the Eiteljorg Museum reached out to Purdue Extension for advice about improving the visual appeal of their most-photographed outdoor spaces. The museum's goal was to do so in a way consistent with their mission to inspire an appreciation and understanding of the art, history, and cultures of the American West and the Indigenous peoples of North America, and that would support future education and interpretive initiatives. They were also keen to establish relationships with local experts and enthusiasts who could assist in the planning and long-term maintenance of these new gardens.

Given the Eiteljorg Museum's mission, the link to using native plants seemed ideal, and Brooke Alford, Urban Agriculture Educator at Purdue Extension – Marion County and INPS Central Chapter President, connected the Eiteljorg with the INPS Landscaping with Natives Team.

The Landscaping team jumped at the chance to showcase the potential for landscaping with native plants at this prominent downtown location. The partnership also provided an exciting opportunity to make steps towards increasing the diversity and inclusivity of INPS, providing opportunities to better understand and to educate about indigenous knowledge and ethnobotanical uses of native plants, and to reach wider audiences.

The Whitetail Deer Fountain

The iconic fountain is a much-photographed focal point at the museum, but the large semi-circular bed surrounding it was struggling. Previous plantings had failed to thrive and a few non-native grasses and thistles were predominant.

The Landscaping design team – Brooke, Sarah Gray, Wendy Ford, Mary Durkin, Aaron Stump, and Coralie Palmer – set to work bringing together native plants that would not only thrive, but also provide aesthetic and ecological value throughout the seasons, and, wherever possible, have cultural significance for indigenous peoples.

An initial design was laid out by Sarah and Coralie, with base maps by Wendy. Sarah's elegant design combines both ecological and cultural considerations while working with relatively challenging site conditions, including a strong wind tunnel effect from neighboring buildings and near-constant splashing from the chlorinated fountain water.

Part 1: A New Partnership

Plants were sourced and cared for by team members with support from Karin Anderson of Native Plants Unlimited. Meanwhile the Eiteljorg team, led by Jay Harkness, La Marr Easter and Ian Poynter, with advice from Brooke and Kevin Allison, worked to prepare the site. May 25 brought beautiful weather, and planting day for the teams.

The Tallgrass Prairie

Early summer saw a profusion of blooms at the newly-planted fountain, and led the Eiteljorg Museum to extend the partnership and ask the Landscaping team back to design the front of the museum. Again, both ecological and cultural considerations were taken into account, together with site challenges – reflected heat from the building and heat from the underground car park below combine to produce very hot, dry conditions. Indeed, on a day of full sun, we observed a wall temperature near 130 °F and nearby soil temperature of 90 °F.

A design team, with additional input from Aaron and Caitlin Osburn, devised a stunning tallgrass prairie-inspired matrix design. On October 4th the Landscaping team together with volunteers from INPS and Master Gardeners worked to install ~500 plants planted before ominous storm clouds could break.

Next Steps and Thank You's

The Eiteljorg Museum hopes to plan similar projects with education and interpretation as primary goals. A third phase on the wooded east side is in the early design stage; this will further incorporate indigenous ethnobotanical links to native plants and a walkway with interpretive signage. If you have interest or expertise in this area, please reach out to Coralie Palmer, landscape@indiananativeplants.org.

The Landscaping team would love to thank all the INPS and Master Gardener volunteers who have donated time and expertise to make this exciting project possible. Additional thanks go to Sarah Gray, Wendy Ford, Brooke Alford, Dee Ann Peine, and Karin Anderson for so generously donating plants; and to Ellen Jacquart, Fiona Becker, Kevin Allison, Dani Tippman, and Greg Monzel for sharing their knowledge in the planning stages. We would also like to express a heartfelt thank you to Mary Durkin, who has been

in on the design process from the beginning, donated numerous plants, and volunteers on an ongoing basis to maintain these plantings. And of course, thanks to Jay Harkness, La Marr Easter, and Ian Poynter of the Eiteljorg Museum for being so open to the idea of native plants on this site, and for their enthusiasm and kindness throughout this project.

Coralie Palmer is on the board of directors for the Indiana Wildlife Federation, owner of Sugarbush Ecological Landscapes, chair of the INPS Landscaping with Natives Team, and a member of INPS Central Chapter.

Editor's Note: Watch for Part 2 in the Spring 2022 issue of the INPS Journal which shall document the garden design and plant selections used at Eiteljorg Museum.

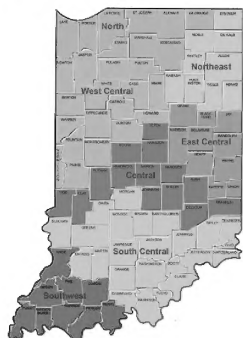


Planting day, May 25, at the Deer Fountain in front of Eiteljorg Museum, Indianapolis.



The completed Deer Fountain planting, season 1.

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Mission

To promote the appreciation, preservation, scientific study, and use of plants native to Indiana.

To teach people about their beauty, diversity, and importance to our environment.

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Youth Education

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Florathon, a Borathon? Heck No! Or: Why the Florathon is the Best Time Ever

By Wes Homoya

(as requested by his mother Barbara)

It's surely a fair assumption of mine that you, dear reader, are a lover of nature—a *biophile*, if you will. So it shouldn't be too difficult for me to persuade you to participate in the spring 2022 INPS Florathon festivities, should it? Well, just in case, here are several utterly undeniable and incontrovertibly compelling reasons to partake.

Oh Florathon, how do I love thee? Let me count the ways:

1) Camaraderie - I'm not being hyperbolic when I say that "Big Days," whether your quarry is feathered or flowered (you may already know that the Florathon is based off the long-loved tradition of Birdathons), provide memories with friends and family that are remembered and referenced for lifetimes. Your team all piled in a vehicle excitedly striving after a shared goal, hearing your crew members shout "I found one!", seeing their smiles after you point out one of your targets – these simple, fleeting, yet profound moments in time are what life is all about, if you ask me.

2) Biodiversity - I reckon this one speaks for itself. Indiana's natural areas, especially its woodlands, are carpeted with dozens of awe-inspiring and unique species in early spring. It's also generally the easiest time to hike them, after the snow melts and before the forest floor fills in with summer's robust understory denizens.

3) Gamification - I looked it up, and yes, it's a word. Let's be honest – in many ways, the Florathon is just an excuse to have an adult treasure hunt. The thrill of tracking down so many

botanical treats for grown-up nerds is like kids and Easter eggs.

4) Altruism - I've saved the most important for last. We treehuggers know how important it is to nurture a culture of ecological literacy (and biophilia!) in our young people. Florathon raises monies for future Loraxes via the Letha's Fund. Knowing that makes all the plant pinpointing endlessly rewarding.

There. I've done it; I've crafted an irresistible invitation to spend time with loved ones, explore our natural areas to find neat plants, devise strategies to crush your competitors, all whilst giving back to your human and non-human communities. You're welcome, Mom. ;-)

Start planning and forming teams now. See y'all out in the woods in a few months.

Wes Homoya is a member of the "Always Be Botanizing" Florathon team along with mom and dad. He is also a member of the Central Chapter of INPS.



Wes Homoya

*The "Always Be Botanizing" Florathon team thrilled by finding a rare plant species, long-bracted frog orchid (*Coeloglossum viride*).*

Start planning now!

***Florathon 2022 runs from
April 16 to May 30!***

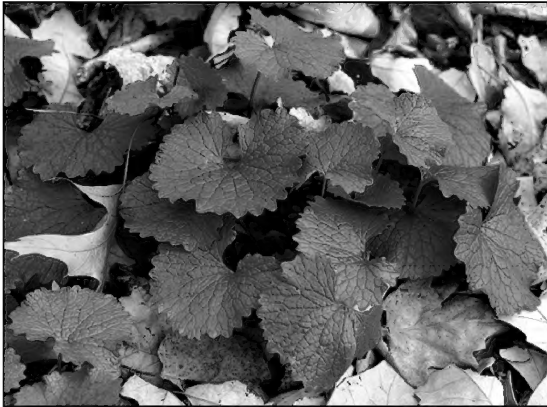
For more info visit <https://indiananative-plants.org/inps-sponsored-events/florathon/>



Wild Edibles: Garlic Mustard

By Michael Hood

Garlic mustard leaves can be harvested in winter! Seek out healthy thriving leaves, which will be more tender, but also less bitter, than those harvested in spring.



Paul Rothrock



Alan Bergo

Garlic mustard raab, with flower buds, is cooked in a manner similar to broccoli. As the flowers open the plant becomes fibrous and the leaves rather bitter.

Garlic mustard (*Alliaria petiolata*), a non-native invasive species, has been consumed by humans for thousands of years. Seeds of the plant were found in pots that are over 6000 years old, along with mammal and fish remains, suggesting that some kind of stew had been made with garlic mustard as a flavoring. In Europe, it continues to be enjoyed by rural people (Kallas 2010). The traditional Greek dish hortopita ('horta' is translated as 'wild greens') is prepared

with wild greens. And garlic mustard is a champion wild green, with high amounts of Vitamins C, E, A (as Retinol Activating Equivalents), beta carotene, zinc, and fiber. It is also high in omega-3, calcium, iron, and manganese (Zennie & Ogzewalla 1977; Kallas 2010).

The garlic mustard genus, *Alliaria*, is a reference to the genus *Allium* which includes garlic and onions (Kallas 2010). The family Brassicaceae includes many edible, pungent flavored vegetables such as kale, broccoli, cauliflower, and brussel

sprouts. The bitter, pungent nature of garlic mustard is due to phytochemicals that repel some herbivores. In garlic mustard these phytochemicals include natural herbicides (also known as allelopathic chemicals) that suppress the germination of neighboring plants (Vaughn & Berhow 1999). However, in other animals that consume them, including humans, these plant compounds may confer

stress resistance and survival benefits.

They can activate a stress response and improve longevity and fitness, just as lifting weights increases strength by breaking down muscle tissue. For example, phytates, once considered to be anti-nutrients, are now being investigated for potential health benefits, especially when consumed in small amounts (Kallas 2010). Plants that grow wild, compared to their more pampered domesticated cousins, produce more phytochemical compounds (Kallas 2010; Haines 2017; Greenfield 2021).

The entire garlic mustard plant is edible – roots, stems, leaves, buds, flowers, and seeds – but the rapidly growing upper stem of the second-year plant is widely considered the best to eat. It is less bitter than the leaves. This meristematic, young plant tissue at the tip of the stem is tender and cleanly snaps off above the woody, more fibrous section of the lower stem, similar to picking asparagus. Aim to harvest before the flower buds develop, as you will get a longer, tender portion of the stem (up to about five inches); this tends to occur as daily high temperatures reach above 50 °F. Once the white flowers emerge, the entire stalk tends to be fibrous. Peak harvest lasts just a few weeks. Retain any young, unopened flower buds and leaves with petioles shorter than a half inch. Cook as you would asparagus spears: blanch the upper stems in a pot of water with one tablespoon salt per quart – cook until al dente (not mushy!). Timing depends upon the degree of tenderness. Top with butter and salt. The young, unripe flower buds of this plant can be cooked like broccoli raab (also rapini or rabe), steamed, boiled, or sauteed in butter (Kallas 2010; Thayer 2010).

The least bitter leaves are those from first-year rosettes. These can be eaten raw, in small proportions mixed with greens and other ingredients to attenuate the bitterness. Chop up and add to salads, or make pesto; if desired, the bitterness can be reduced by blanching for 1-2 minutes (Thayer 2010).

The bitter leaves of the second-year aerial stems get more so as the season progresses, and those are generally cooked as potherbs

Native Plant of 2022

(cooked greens), preferably mixed with other greens. In fact, hortopita is generally made with a mix of wild greens – in Greece, over 170 wild greens are used to make this dish! I love being able to eat many different wild greens and edibles, not only for the wider variety of flavors, but also for the increased variety of healthful phytochemicals.

Garlic mustard seeds are collected when they are mature (turn brown), after the terminal seedpods split open. Try crushing the hard seeds to make mustard.

The more you experiment with cooking with this plant (or any wild edible), the more likely you will find a way to enjoy it and thus eat it more often. A good way to find a preparation that you like is to try traditional recipes. Since garlic mustard is native in Europe and has been used far longer than in North America, I suggest searching for recipes using other European common names: hedge garlic, jack-by-the-hedge, and sauce alone.

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Michael Hood, a member of INPS South Central Chapter, is an avid forager of wild edible plants, fungi, and medicinal herbs, and has organized numerous gatherings for foragers. He is a three-time winner of the cooking competition at the Great Lakes Foragers Gathering.

INPS, through a vote by its membership, has selected its first Native Plant of the Year – butterfly milkweed (*Asclepias tuberosa*). It beat out four other fine candidates.

According to our *IndianaNativePlants.org* website:

- ✿ Butterfly milkweed is one of the most beautiful milkweeds, and provides essential habitat for larvae of the beloved Monarch butterfly (*Danaus plexippus*). It is considered one of the best varieties for an ornamental garden as it does not spread by underground runners.
- ✿ The bright orange flowers are attractive to many varieties of butterflies, bees, hummingbirds and other pollinators.
- ✿ Butterfly milkweed is a drought resistant/drought tolerant plant. It is also resistant to deer browse. This sun-loving Indiana native plant can be grown in every region of the state. Butterfly milkweed is good in clay, loam, and low fertility soil.



Paul Rothrock

Butterfly milkweed, and other milkweed species, have remarkable flower structures. These include tapering "horns" that curve upward from the throat of the "hoods." They also attract a range of pollinators, including the sweat bee (family Halictidae) seen on this inflorescence.

It should provide an excellent way to promote more appreciation, understanding, and use of native plants as we share INPS with those we encounter. 🍂

Book Review:

Sedges of Indiana and the Adjacent States: Volume II – The *Carex* Species

By Paul E. Rothrock

Reviewed by Scott Namestnik

Professional and amateur botanists alike often turn the other way, or worse, cower in fear, when they hear the word *Carex*. This genus of graminoids includes an intimidating number of species that, to the uninformed eye, can look superficially similar to one another. However, as a ubiquitous genus represented in natural and ruderal areas from wet to dry, in full sun to full shade, and in soils ranging from sand to clay, being able to identify or at least appreciate *Carex* is a necessity for anyone working with native plants.

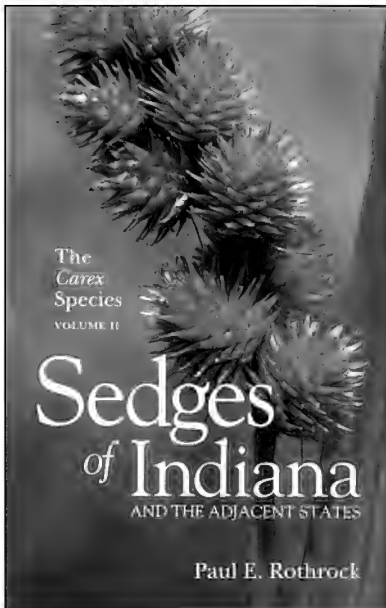
Sedges of Indiana and the Adjacent States: Volume II – The Carex Species (Indiana Academy of Science 2021) fills a void by providing a user-friendly field guide to the 158 species in this challenging genus that are known to occur in Indiana, as well as an additional 37 species known from

work to his first volume on the non-*Carex* species (Rothrock 2009).

Although its size makes it ideal to include in a field pack, *Volume II – The Carex Species* is much more than just a field guide. The book begins as expected with sedge morphology and terminology, information (including annotated images) that helps the uninitiated know what to look for. In addition, the introduction includes a synopsis of where and when to find various *Carex* species in the wild. Unlike other field guides that may seem dry or not useful for native landscaping purposes, a section of the introduction addresses appropriate sedge species for various gardening situations. Following the introduction are guest essays by two of the other foremost sedge experts in North America, Andrew Hipp and Tony Reznicek, a feature that adds to the amazing expertise on the genus already provided by the author.

A dichotomous key to the sections of *Carex* allows the user to see similarities in groups of sedge species that, over time, will allow one to more quickly narrow down the identity of an unknown sedge species as they become more familiar with the “look” of the various groups of species. Following this dichotomous key, the species of *Carex* are discussed by section.

The format of the species accounts will look familiar to those who have used *Sedges of Indiana and the Adjacent States: The Non-Carex Species*, as they begin with botanical name, common name, and etymology, as well as distribution maps for Indiana and the six-state region. Brief descriptions of the species and information on the habitat, likely associated plant species, abundance and frequency within the region, and a discussion follow; the discussion includes interesting bits of information such as similar species, ecological relationships, and general natural history notes. For sedges with recognized taxonomic levels below the species level, a key to subspecies or variety is included. All of this would ensure a very useful guide on its own, but the greatest attribute of the guide is the number of high-quality images that show various aspects of most of the species treated



About half of *Carex* species, including *C. comosa*, favor wetland habitats.

the surrounding states of Wisconsin, Illinois, Kentucky, Ohio, and Michigan. This synthesis of a half century of work by the respected Caricologist (and all-around good guy!) Paul Rothrock is the highly anticipated follow-up

in the book, including inflorescence, closeups of perigynia and pistillate scales (from herbarium specimens), sheaths, and habitat; these photographs were clearly chosen to illustrate some of the most important identification characteristics of each species. In addition these images portray the diversity and beauty encompassed by the many species of this fantastic genus.

The book concludes with several appendices, including a summary of the *Carex* species treated in the guide and their coefficient of conservatism (C) values and wetness indicator statuses (useful for those doing wetland delineation work), a summary of nomenclatural changes and additions and subtractions of *Carex* species in Indiana's flora since Charles Deam's 1940 *Flora of Indiana*, a remarkable section on ant species that use *Carex* (by Laura Rericha, co-author of *Flora of the Chicago Region* (Wilhelm & Rericha 2017)), and an addendum to Rothrock (2009) that updates the status and taxonomy of the non-*Carex* species. A comprehensive glossary rounds out the book.

Any work of this extent will inevitably have some shortcomings, but in this case those are extremely difficult to find. The only criticism (and a trivial one at that) is that there are not images of species known from the region but not known from Indiana that are covered in the book, and in a couple of rare instances where a *Carex* species is only known from one or two counties in Indiana, images are not included. This critique is quite easy to overlook given the impressive number of high-quality images that illustrate the diversity of species covered.

The author's passion for *Carex* is evident through this impressive work. The second volume of *Sedges of Indiana and the Adjacent States* was well worth the wait, and field botanists and nature enthusiasts alike will benefit from having this beautiful guide as a reference in the field or inside the home/office. At a minimum, results of this book should include "*Carex* sp." showing up less frequently on data sheets of professionals conducting field botany work, and hopefully we see increased utilization of various *Carex*

in native landscaping. As aptly stated by the author himself, this book represents "a ticket to a lifetime of exploration" for anyone willing to take on the challenge of learning about one of the most interesting genera in our flora, *Carex*.

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Scott Namestnik is the botanist at the Indiana Natural Heritage Data Center, housed at the Indiana DNR – Division of Nature Preserves. He serves as the INPS Journal Team Leader and is a member of INPS North Chapter.



The lovely graceful sedge (Carex gracillima) is one of over two dozen species recommended for an ecologically sensitive landscape design.



The perigynia of C. communis have white tissue at the base that attract ants who disperse them.

Paul Rothrock

Some Small

By Vic Riemenschneider

No, this is not an article about clothing! It is about the smallest of Indiana's flowering plants, species from the duckweed family (Lemnaceae). In fact, the duckweeds include the smallest of all flowering plants (Landolt 2000), with watermeal species (*Wolffia* spp.) being the champions.

The green structures of duckweeds are called fronds, a combination of stem and leaf, and only some species have roots. The watermeals have no roots; just fronds that are boat or barrel shaped. The fronds are floating and up to 1.6 mm (1/16") long. In northern Indiana, there are three species listed by Wilhelm & Rericha (2017).

I took two surface water samples from Spicer Lake County Park, St. Joseph County, in October 2020 and discovered all three of the species listed by Wilhelm & Rericha (2017). By contrast, samples collected at South Bend-Elkhart Audubon Wildlife Sanctuary pond over the summer and fall consisted of only one species. In order to fully appreciate the details of these plants I used a dissecting microscope with up to 45× magnification and a Nikon 4500 camera mounted on the phototube to obtain pictures. Although they are small, it is possible to see the flowers and other features through a 10× hand lens.

The most common species that I observed was dimpled watermeal (*Wolffia brasiliensis*). These boat-shaped plants have a papilla (dimple) in the center of the upper surface. The fronds I measured were about 1.2 mm long, 1 mm wide, and 0.6 mm deep. You might be able to make out the stomata¹ which appear as faint white dots. Most reproduction in water meals is asexual, the young growing from a pocket at the side of the adult. The photo (p. 15) shows a young frond emerging from the right side of the adult frond. Strands of *Spirogyra* algae give the green color to the background. The upper surface of the frond contains the chlorophyll and the lower part has some dark pigmented cells and clear air-containing cells. Dimpled watermeal, as with duckweeds in general, is found in quiet waters (Landolt 2000). It ranges from Canada to South America and undoubtedly gets carried long distances by migrating birds.

Spotted watermeal (*Wolffia borealis*) also is boat shaped, but has no papilla and has a point at its apex. It is 0.7-1.5 mm, 1.3-2 times as long as wide and 0.7-1 times as deep (Landolt 2000). This was much less common; I only found a couple in the Spicer samples

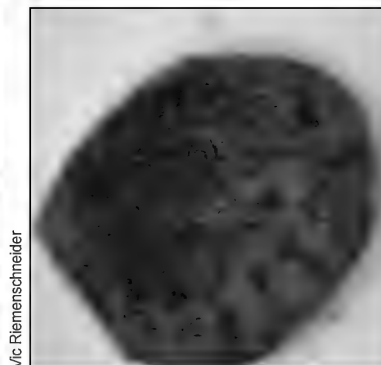
Footnote

¹ Stomata: pores that allow gas exchange between the plant tissues and the atmosphere.



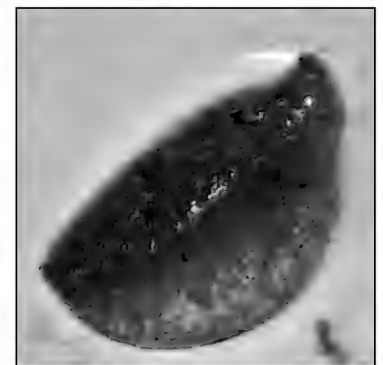
Paul Rothrock

A macroscopic view of duckweeds floating atop a lily pad (*Nymphaea* sp.). Yellow arrow: the genus *Lemna*. White arrow: the genus *Wolffia*.



Vic Riemenschneider

American watermeal. All of the photos from here to right were taken at 45× on the dissecting microscope.



Spotted watermeal.

Bloomers

and did not measure them. The cells in the lower surface of this frond are more visible than the previous one.

American watermeal (*Wolffia columbiana*) has barrel shaped or globular fronds (0.4–1.2 mm) that are rounded at their apex and lack papillae. Wilhelm and Rericha (2017) considered this species abundant in still waters and it was present in both the marsh and woodland wetland at Spicer Lake, but I did not notice it in the Audubon pond. Of the three species, American watermeal has the smallest geographical range, limited to temperate regions of North America.

By now, you are wondering, where are the flowers? They are very rare in the family Lemnaceae. However, I did find flowering individuals of dimpled watermeal at the Audubon pond in late summer and early fall and some more mature stages at Spicer Lake wetlands. The flowers have no sepals or petals, just one stamen and one pistil that is bottle-shaped with a short funnel stigma (see more photos at Armstrong 2020). The pistil matures before the stamen, which assures outcrossing. Only one seed is formed in *Wolffia* (Landolt 2000).

The photo shows the funnel shaped stigma protruding above the surface of the frond. There are some questions as to whether there

is one flower or two flowers in the Lemnaceae (Landolt 2000). Is this the pistil of a single bisexual flower or a separate female flower?

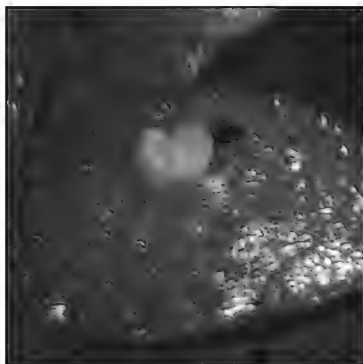
The stamen emerges after the stigma is no longer receptive. In the photo you can spot the stamen anthers (white) with the dark spot next to it being the withered stigma.

The plant bodies of watermeal feel granular or mealy when rubbed between the fingers. I was able to easily harvest a sample for members of the northern chapter of INPS during a field trip to Spicer Lake by simply dipping my finger into the water and pulling it out. It was covered with *Wolffia*. *Wolffia* fronds are eaten as a vegetable in Southeast Asia. We did not try to see if they were “finger licking good.”

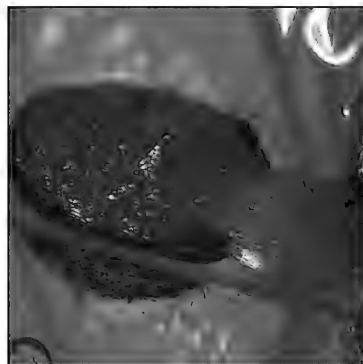
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Vic Riemenschneider is a retired Biology faculty member from Indiana University – South Bend and a member of the North Chapter of INPS.



Dimpled watermeal with white anthers and withered stigma.



Dimpled watermeal producing a young frond asexually.



Dimpled watermeal with a female stigma.

Vic Riemenschneider

I Have to

By Nate Simons

Even an RV park can protect natural lakeshore, home to numerous species of native wetland plants.

In May 2002, Blue Heron Ministries was contracted to complete a wetland delineation on the shores of Barton Lake in Steuben County. The delineation was in preparation for development of the shoreline and adjacent lands as a recreation vehicle park. The

recreation vehicle lots along the property's undeveloped shoreline, each with a dock for mooring residents' boats, and to create a swimming beach for the community.

The wetlands delineation revealed 10.6 acres of jurisdictional wetlands (i.e., wetlands regulated under the Clean Water Act) along the shoreline. The wetlands included overgrown scrub-shrub plant community and a degraded sedge meadow/marl beach.

Upon consultation with the landowner, it was agreed that placing fill in the shoreline wetland for development of recreation vehicle lots would likely not be permitted by the Army Corps of Engineers and Indiana Department of Environmental Management (IDEM). So, the property-owner, a life-long resident of the lake and one who appreciates things natural, revised his plan. He would move the lots to high ground under one condition...that the future residents of those lots could be assured that they would have a view of the lake and access for the mooring of boats.

The new concept for the project became the creation and restoration of a beautiful, native sedge meadow as the foreground focus for a communal view of the lake. Three boardwalks through the sedge meadow would lead to group piers for boat docking.

With approval by IDEM, the restoration began in the winter of 2003. The plan was to remove the heavy, view-obstructing woody brush, control invasive herbaceous species, and maintain the resulting wet-prairie with annual prescribed fire. The landowner performed much of the brush removal himself. The work proved difficult as the jungle of box elder (*Acer negundo*), pale dogwood (*Cornus obliqua*), red-osier dogwood (*C. stolonifera*), willow (*Salix* spp.), and poison sumac (*Toxicodendron vernix*) was nearly impenetrable. The owner settled for partial removal due to an outbreak of contact dermatitis.

By the summer of 2003, the newly-exposed muck soils, devoid of shade, spontaneously grew a rich cover of native herbaceous grass, sedge, and forb¹ species. Not surprisingly, though, the mix also included invasive species. But the landowner was pleased



Nate Simons

White water-lily (Nymphaea odorata) and hardstem bulrush (Schoenoplectus acutus) inhabit the littoral zone of the natural shoreline of the Collins Bay RV Park on Barton Lake; 21 October 2021.

95-acre natural lake located near the Indiana-Michigan border was already degraded with typical Indiana lake development. Although not large enough to be classified as a "ski lake," the shoreline sported a dense assemblage of small homes and excavated channels to the lake, a mobile home park, a recreation vehicle park, and a water park. The lake was enjoyed as a backdrop for fishing, swimming, and slow-speed boat rides. The addition of another recreation vehicle park seemed to fit the lake's existing uses.

The original plan was to crowd sixty

See the Lake

with what he saw. He (and his future clients) could see the lake.

Under a renewed contract, Blue Heron Ministries set out to manage the vegetation, to move the entire wetland toward a native wet-prairie. In the spring of 2004, the first prescribed fire was conducted to stimulate herbaceous vegetation growth and top-kill the remaining woody species. During the next four springs and summers, prescribed fires were set and invasive plants were systematically controlled with spot-applications of wetland-approved herbicide. The highly-invasive glossy buckthorn (*Frangula alnus*) was eliminated. Hybrid cat-tails (*Typha* × *glauca*), reed canary grass (*Phalaris arundinacea*), purple loosestrife (*Lythrum salicaria*), and Canada thistle (*Cirsium arvense*) became targets for annual eradication maneuvers.

The owner thought it might be a hard sell; “Come to the lake, but you can’t mow the communal front yard.” But within a year or two, lots were rented and recreation vehicles sprouted. And from those lots, the community of folks liked what they saw. Many have commented that the native shoreline was different than what they expected; but they see it as an attractive asset to the community.

With that initial success, Blue Heron Ministries has returned annually in the spring to set the place on fire and in the summer to keep out the ever-invading weeds. In the wake of proper care, what has emerged and spread from the soil’s seedbank² includes a suite of sedges such as hardstem bulrush (*Schoenoplectus acutus*), and twig rush (*Cladium mariscoides*); patches of native grasses like blue-joint grass (*Calamagrostis canadensis*) and prairie cord grass (*Spartina pectinata*); and a kaleidoscopic bouquet of wildflowers including Ohio goldenrod (*Solidago ohioensis*), Riddell’s goldenrod (*Solidago riddellii*), New England Aster (*Symphyotrichum novae-angliae*), Virginia mountain-mint (*Pycnanthemum virginianum*), spotted joe-pye weed (*Eutrochium maculatum*), flat-topped aster (*Doellingeria umbellata*), tall sunflower (*Helianthus giganteus*), and an occasional lesser fringed-

gentian (*Gentianopsis virgata*). Poison sumac is still around but exists as individual, waist-high stems.

As a testament to the restoration efforts, residents of the park can now welcome a pair of sandhill cranes that nest in the bulrushes and teach their young to hunt the sedge meadow for crustaceans and amphibians.

What started as a plan to continue the theme of developing and domesticating yet



Nate Simons

In mid-autumn, the white fluff of members of the aster family and contrasting fine-textured native grasses and sedges continue to add beauty to the restored wet-prairie front yard of Collins Bay RV Park.

another northeast Indiana lake shoreline has turned, with the thoughtfulness of a local developer and the stewardship efforts of caring restorationists, into a beautiful, high-quality, and life-filled aquatic habitat. It is a bit of a paradigm shift, but folks can live with wetlands in Indiana lake country.

Footnotes

¹ A forb is an herbaceous broad-leaf plant that generally has showy flowers.

² A seedbank is a reservoir of dormant seeds in the soil.

Nate Simons is Executive Director of Blue Heron Ministries, an ecological restoration and faith ministry located in Angola, Indiana.

Observations — continued from back cover

water levels that stop almost all growth of plants along the low banks of the Ohio for the rest of the season. Drought years are indeed the most interesting; the low water level results in long stretches of sun-exposed shoreline that produce a plethora of plant species.

The variety of plant habitat along the Ohio in the late season is impressive, and frankly exciting to a plant hunter. It's all about the topography. For example, the New Albany area has wide expanses of exposed shale whereas in Harrison and Crawford counties the river has cut through the Knobstone Escarpment leaving narrow

categories. The "emergent" type tolerate being dry but often have "wet feet." These constitute the bulk of riverbank species. The second type, the true aquatics, grow submerged in water or floating on it. They require placid water without the scouring currents.

Rooted aquatic plants such as sago pondweed (*Stuckenia pectinata*), tape grass (*Vallisneria spiralis*), or the invasive water-thyme (*Hydrilla verticillata*) tend to show up in shallow water close to shore. Water closest to the shore actually flows much slower than at the center of the stream, not to mention the great turbulence produced by the mammoth barges heading up and down the main channel of the river. Floating aquatics such as duckweeds (*Lemna* spp.) can commonly be found stranded in the seeps and seasonal water pools and sometimes appear to grow on the ground. The embayments of the many smaller tributaries provide additional slow water habitat.

The immediate floodplain supports a long list of emergent species. Some common forb species that I love to spot include several *Amaranthus* species, false daisy (*Eclipta prostrata*), the dainty false pimpernel (*Lindernia dubia*), vividly colored grand redstem (*Ammannia robusta*), false buttonweed (*Spermacoce glabra*), Virginia buttonweed (*Diodia virginiana*), and primrose-willow (*Ludwigia decurrens*) with its curious fruits. Sedges abound, e.g., flat sedges (*Cyperus*) and spike-rushes (*Eleocharis*) species. Grasses flourish on the moist sandy shores and can be dramatic — witch grass (*Panicum capillare*) and water paspalum (*Paspalum repens*) — as well as dainty love grass (*Eragrostis* spp.). This is also a good place to see the shrub false indigo (*Amorpha fruticosa*) and the high climbing woody vine American wisteria (*Wisteria frutescens*).

The good news for those of us who love plant hunting is that access to the Ohio River has become much easier in recent years. The scourge of spring flooding has driven many municipalities to turn riverfront property into parks and greenways. Boat ramps are also common along the river and provide shoreline access as well as parking. It is easy to explore below the four lock/dam complexes along the Indiana border during the low water season. Markland Dam has a park on the Indiana side complete with a long concrete staircase going down to the sandy beach below.

— continued at right

Paul Rothrock



Bill Thomas



This extensive sandbar near the Falls of the Ohio has an abundance of willows (*Salix* spp.) and Eastern cottonwood (*Populus deltoides*) that hide the view of the river channel. It also harbors late season sedges and the annual vine, trailing fuzzy-bean (*Strophostyles helvola*).

strips of alluvial soil or flat rock overtopped by high limestone bluffs. Desert-like stretches of sand are common in the flatter areas with numerous seeps and small creeks trickling out of the higher flood eroded dirt bank. Some areas produce small seasonal pools and deeply cut ravines with calm shallow water. Some stretches of shore provide a multiplicity of different habitats all in the same general area.

Plants along the shores of the Ohio fall into two

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— continued from left

The McAlpine Dam has the wonderful Falls of the Ohio State Park and fossil beds on its lower level. The Cannelton Dam has a park along the Indiana side but riverbank access is limited. The Newburgh Dam has two parks as well as the Rivertown Trail which runs along the river to the historic town of Newburgh. In the more remote areas just follow the fishermen!

Over the past 20 years Bill Thomas has made almost 6000 plant collections. These include numerous county and even state records. During the winter he volunteers his time in the herbarium at Indiana University - Southeast.



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Observations of an Ohio River Plant Hunter

By William Thomas

Paul Rothrock



Bill Thomas



Indiana's southern border is mostly a wet one, though not entirely so. The Ohio River, which draws its water from over 200,000 square miles and 15 states, serves as the separating line between Indiana and Kentucky. Specifically, the border is the low water mark that existed in 1792 when Kentucky became a state. Kentucky actually owns the lion's share of the river and even a few small plots of dry soil on the Indiana shore. One example is in the southeast corner of Evansville, an area known as Green River Island. Here you can botanize both states without crossing the river or even getting your feet wet!

Because of the requirement to maintain commercial navigation along the Ohio River, the extent and duration of flooding along this behemoth river is more or less on an annual cycle and as much as possible under human control. Spring rains reliably produce several minor flooding events every year along the Ohio and with great variability major floods every 10 years or so, and some of epic proportions called 100-year floods. Plants and humans making a home along the edges of the Ohio River live a life of great uncertainty. For the average river-rat botanist, the floodplain can basically be divided into two zones. The immediate flood zone covers the areas that are inundated multiple times every spring without fail until late May or early June. These areas, unlike the flash flooded areas of smaller rivers, will often remain underwater for weeks at a time or be clad in brown mud when not, with nothing green showing up till mid-spring. In contrast, the upper flood zone is only touched in years of major floods.

For a plant hunter like me, the floral treasures you stumble on along the shoreline is dependent on the quantity and timing of the rain. In most years, the low floodplain along the Ohio is a fun activity for late summer and fall. But at times the rains continue into the summer months resulting in persistent high

Observations — continued on page 18

The wet crevices of this shale outcrop near Silver Creek are populated by tenacious American water-willow (Justicia americana), a species with striking bilaterally symmetrical flowers.